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# INSTRUCTIONS
## FOR USING THE
## New-invented ORRERY,

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~~8.~~

MADE AND SOLD BY

**RANDLE JACKSON,**

CLOCK-MAKER,

No. 8, CHAPEL ROW, SPA FIELDS,
LONDON:

OF WHOM MAY BE HAD

Complete ORRERIES, PLANETARIUMS, &c.
as invented by Meſſrs. *Ferguſon* and *Martin*.

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# INSTRUCTIONS

## FOR USING THE

## New-invented ORRERY.

THE following plain Inſtructions will, it is hoped, ſerve as a uſeful Introduction to the Uſe of the ORRERY, and at the ſame Time ſmooth the path to the SCIENCE of ASTRONOMY.

§ 1. The Board on which the Frame of Wheels, *&c.* turns, has a printed paper paſted on it, near the outward edge of which are ſeveral Circles.

§ 2. The firſt or outward circle is divided into Twelve Parts, containing the names of the Twelve Months of the Year, and the next circle into their reſpective Days; the two inmoſt circles have the Twelve Signs of the Ecliptic; each ſign containing 30 degrees, and conſequently the whole Ecliptic 360 degrees. The Ecliptic Circle repreſents that path in the Heavens which the Sun ſeems to deſcribe in a year, though it is properly the path of the Earth round the Sun.

§ 3. The Braſs Ball fixed in the center of the Board repreſents the Sun in the center of our Univerſe.

§ 4. The Ivory Ball, with ſeveral circles cut on it, repreſents the Earth; and the Braſs Pin that it is ſupported on, the Axis of the Earth. This Braſs Pin has an inclination to the Board on which it goes round, thereby giving the Earth its proper poſition, called by Aſtronomers the Inclination of the Earth's Axis to the Plane of the Ecliptic. This poſition never varies, and is therefore termed the Earth's Paralleliſm to itſelf: It is this invariable poſition of the Earth that cauſes the changes of the Seaſons, and the different Length of Days and Nights.

§ 5. The top of the Pin on which the Earth turns is called the North Pole, and the bottom the South Pole: The two circles near theſe two Poles are termed Polar Circles, the upper one the North Polar Circle, and the under one the South Polar Circle; The two circles next to theſe are called the Tropics; the upper the Tropic of Cancer, the under the Tropic of Capricorn: The circle in the middle, between the Poles, is called the Equator, becauſe it equally divides the Earth; for when the Sun is over that part of the Earth it is equal Day and Night all over the Globe. There is another circle which croſſes the Equator, and touches the Tropics in two points; this circle repreſents the path over the Earth that the Sun makes in a Year, and is called the Ecliptic.

§ 6. There are twenty-four other circles, which are called Meridian Circles, all meeting at the Poles, and croſſing thoſe juſt mentioned: Theſe anſwer to the twenty-four Hours of the Day; in which time the Earth turns once round the Axis, making one Day and one Night, as will be ſhewn hereafter.

§ 7. There is a ſmall Piece of Braſs put on the uarth, nearly between the upper Tropic and Polar Circle, which repreſents the place of London on the Earth, by which the various changes that this metropolis undergoes are more clearly ſhewn.

§ 8. The ſemicircular Braſs Wire that is ſuſpended over the Earth, repreſents the boundary of Light and Darkneſs thereon. That half of the Earth on that ſide of the Wire which is next the Sun is called the enlightened Hemiſphere, and the half on the other ſide the darkened Hemiſphere.

§ 9. The ſmall plain Ivory Ball denotes the Moon, and is carried round the Earth in 29 days and a half, by means of the Braſs Arm that communicates with the wheel-work in the Frame. For one revolution of the Earth round the Sun this Moon goes 12 times and one third round the Earth, the ſame as the Moon in the Heavens. The Moon is fixed on a Wire, which moves up and down in a ſocket at the arm before mentioned, ſo that the Moon may have her proper inclined motion, in reſpect to the Earth's, given her by the help of

§ 10. A flat Braſs Open Rim, fixed under the Earth, moveable two ways, *viz.* either horizontally or vertically. By the vertical motion any inclination may be given to this rim or orbit of the Moon. By the horizontal motion the rim may have its poſition or ſituation with reſpect to the ſigns of the Ecliptic properly regulated. That joint of the rim where it cauſes the Moon to begin to aſcend above the orbit of the Earth is called the aſcending Node, and the oppoſite joint of the rim the deſcending Node: Theſe two Nodes in the Heavens have a retrograde motion through the Signs of the Ecliptic in 19 years. The true poſition of them for any particular time may eaſily be found, as their places in the Ecliptic are in all Ephemeris's for the given year; and their places may be ſet in the Orrery accordingly.

§ 11. There is another Rim, fixed under the one above mentioned, having all the Signs and

Degrees of the Ecliptic inſerted on it; which ſigns the learner ſhould know by heart, ſo as to call them by their names when ſeen. This Ecliptic Circle alſo ſerves to ſhew the Moon's Place in the Heavens, as ſeen from the Earth; and alſo the diſtance from the Sun that ſhe appears to have at any ſituation of her, in her orbit; for this Ecliptic, as well as the orbit of the Moon, and the Earth, keeps its parallel iſm, or all the ſigns and degrees parallel to thoſe on the Board, and its revolution round the Sun, with the Earth.

§ 12. Under the above two circles is a Card, which is fixed to the Frame of Wheels by two ſcrews. This Card has the Age and Phaſes of the Moon on it, with the initial letters N. M. 1 Qr. F. M. 3 Qr. ſignifying, that when the Wire Arm that carries round the Moon is over any of theſe letters, it is, according to the letters the wire is over, either New Moon, the Firſt Quarter of the Moon; Full Moon, or the Third or Laſt Quarter of the Moon: Alſo when the above arm is over any Phaſe and Number, it ſhews the Quantity of Light on the Moon that appears to the Earth at the age there figured.

§ 13. There is a ſmall Tin Lacquered Lamp given with the Orrery, which is to be lighted with oil and a very ſlender wick of cotton, then to be placed on the Wire that the Braſs Ball denoting the Sun is ſcrewed to; which Braſs Ball muſt be unſcrewed, and the ſocket at the bottom of the

Lamp put on in the room of it. When the Lamp is uſed, the room where the Orrery is ſhould be made quite dark. This Lamp has an excellent effect in the uſe of the Orrery, for every thing it is capable of repreſenting, is, as it were, realized by the Light of this artificial Sun.

And now the Student, having been made acquainted with the ſeveral parts of the Orrery, will find it neceſſary to proceed to learn the *uſe* of thoſe parts.

The firſt thing, then, to be learned in the uſe of the Orrery is, how to *rectify* it, which is as follows:

*Firſt*, On the Frame near the Sun, is a long Braſs Wire, which ſerves as an Index to point out the ſeveral places of the Sun; ſo that when this Index points out the Sun in any particular ſign and degree, it is evident that the place of the Earth is in the oppoſite ſign and degree of the Ecliptic: As for example, Hold the Board with one of your hands ſteady on a table, and then with the other hand turn the Frame of Wheels round, by a ſmall Ivory Handle fixed on the end of the Frame fartheſt from the Sun, 'till the Index points to the 21ſt of June, or to the firſt degree of Cancer, which ſhews, that, at that time of the year the Sun appears to be in the beginning of Cancer, and the Earth is in the beginning of Capricorn. You muſt obſerve at the ſame time, that the ſigns of Cancer and Capricorn on the Board are in a line with the ſigns of Cancer and Capricorn on the ſmall Ecliptic under the Earth; if not, move the ſmall Eliptic about until they are ſo. Obſerve alſo, that the inclination of the Earth's Axis is towards the ſign of Cancer, and if it is not, move its ſupporter round the Steel Wire until it is ſo; then turn the Frame round, until the Index points to the Day of the Month you would rectify it for. By this means may the Orrery be rectified for any time required.

*Secondly*, By keeping the Earth in the above poſition, and turning it round its Axis with your finger, the ſame way as the order of the ſigns is, the Earth will then repreſent the daily motion of the real Earth round the imaginary axis in 24 hours. As you keep turning the Earth, the Braſs Piece denoting London will, when in the middle of the enlightened half of the Earth, ſhew that the Sun is then on the Meridian, or it is Noon; but as you keep turning the Earth, London will be brought to the boundary wire; the Sun then to the Londoners is beginning to ſet; and when London is paſt the wire, the Sun is quite ſet, it being to them Evening, and conſequently in darkneſs; when it is in the middle of the other Hemiſphere, it is to them Midnight; but arriving at the other ſide of the boundary wire, the Sun begins to riſe, and London then enters the enlightened Hemiſphere, called Morning, and ſo on as before.

*Thirdly*, In order to ſhew the different Lengths of Days and Nights and of the four ſeaſons, Spring, Summer, Autumn, and Winter, you muſt move the Frame of Wheels on, according to the order of the Months or Signs, until the Index at the end of the Frame points to the 20th of March, or the firſt degree of Aries, which ſignifies, that the Sun, on the 20th of March, enters the ſign of Aries. Now looking at the Earth, you will perceive that the Equator is oppoſite to the center of the Sun, or that the Sun is over that part of the Ecliptic which croſſes the Equator, and aſcends to the Tropic of Cancer; and that the North Pole is exactly under the boundary wire; that the number of circles on each ſide of the wire is twelve; and by turning the Earth round its Axis we find that there is always that number; and as one half of the Earth is in light, and the other half in darkneſs, conſequently on the 20th of March there is Equal Day and Night all over the Earth. This is called the Vernal Equinox, and the ſeaſon of the year is Spring.

*Fourth*, Then by moving the Frame gently on, you will perceive the North Pole to come more and more into the light, and the quantity of hour circles or Meridians between the Equator and the North Pole to encreaſe, and conſequently the length of days encreaſe at that part of the Earth, thoſe having the longeſt days who live neareſt the Pole. Turn the Earth round its Axis, you will ſee that the ſituation of London, at Sun-riſing and at Sun-ſetting, is at the diſtance of 16 hours and a half; and at Sun-ſetting and Sun-riſing about 7 hours and a half, which is the length of day and night at this time of the year at London, being the 21ſt of June; and as the Sun is over that part of the Ecliptic which touches the Tropic of Cancer, it is to the Northern Inhabitants the Longeſt Day and the Shorteſt Night; and the middle of that ſeaſon of the year is called Summer.

*Fifth*, By moving the Frame on, you will perceive part of the Polar Circle to retire under the boundary wire, until the 23d of September, or when by the Index the Sun enters Libra. On that day the poſition of the Earth is every way the ſame as it was on the 20th of March, only at this time of the year it is called Autumn, or the Autumnal Equinox.

*Sixth*, When you proceed to move the Frame on, you will ſee the Polar Circle will be diminiſhing until the 21ſt of December, when the Sun enters Capricorn, and is over that part of the Ecliptic on the Earth that touches the Tropic of Capricorn, when the North Polar Circle will be entirely in the Dark Hemiſphere, and the quantity of hour circles on the North ſide of the Equator leſs in the Enlightened Hemiſphere than in the Dark Hemiſphere. The poſition of the Earth this day is in all reſpects the contrary of that on the 21ſt of June, the time of light at London being only about 7 hours and a half, and that of darkneſs 16 hours and a half; and the time of the year is called Winter.

*Seventh*, Again by turning the Frame until the Index points to the 20th of March, the year will then be completed, and the poſition of the Earth the ſame as when you firſt began to move it.

*Eighth*, While you are turning the Frame ſlowly on, look at the North Pole, and you will ſee that it is conſtantly in the Light from the 20th of March to the 23d of September; and from the 23d of September to the 20th of March conſtantly in the Dark; which ſhews that there is but one day and night at each Pole; that they are of ſix months continuance, and when it is Day at the North Pole, it is Night at the South Pole, and ſo the reverſe: Alſo when it is Summer to the Northern Inhabitants, it is Winter to the Southern, and ſo the contrary.

*Ninth*, If you continue to move the Frame of Wheels on the Board, you will perceive that while the Index goes through a month, the Moon will make juſt one revolution in her orbit, called a lunation; in the courſe of which lunation, when the Moon is between the Earth and the Sun, ſhe is called a New Moon; when moved a quarter round, in her firſt quarter, according to 1 Qr. as is ſeen on the Card; when half round, a Full Moon; and when three quarters round, in her third quarter, and ſo on as before; but to repreſent her Phaſes, or Appearance, as alſo the Eclipſes, more perfectly, we ſhall ſuppoſe the Board, (as directed in § 13,) and then as you move the Frame on, you will ſee how the Moon ſhews herſelf as ſeen on the Earth, as alſo her age, and ſituation in her orbit, expreſſed by the aforementioned Card; for when the Moon comes between the Earth and the Sun, or is new, her dark ſide will be towards the Earth, (ſhe having no other light but what ſhe receives from the Sun, and reflects to us) conſequently ſhe will not then be viſible, unleſs ſhe eclipſes the Sun, which you will ſee by her ſhadow falling on the Earth, and the ſhadow will be high or low on the Earth, according as the Moon is high or low in her orbit. This Eclipſe is called an Eclipſe of the Sun, though, properly, it is an Eclipſe of the Earth; and all thoſe inhabitants who are in the ſhadow will ſee the Sun as eclipſed, and more or leſs ſo as they are farther from, or nearer to, the center of the ſhadow, from whence it is called either a Total or Partial Solar Eclipſe.

*Tenth*, Turn the Frame on, 'till the Moon is in the oppoſite part of her orbit, or is Full; then you will perceive that the Moon's enlightened Face is towards the Earth, except ſhe falls into the ſhadow of the Earth, which if ſhe does there is then a Lunar Eclipſe, or an Eclipſe of the Moon, and will be viſible to all thoſe inhabitants, that are in the Darkened Hemiſphere.

Thus having given my young friends the neceſſary Inſtructions for *uſing* my portable Orrery, I ſhall now leave them; and am fully perſuaded, that, by frequently amuſing themſelves with this ſimple apparatus, they will ſoon gain a pleaſing knowledge of the Earth's and Moon's motion round the Sun, and have a juſt idea of the other planets, as their motions are the ſame way, and by the ſame cauſe.

But as ſome perſons may wiſh to have a complete Set of the Planets, I beg leave to inform them, that they may be furniſhed with a Set of ſmall Arms, containing all the Planets, to apply on the Board occaſionally, inſtead of the Earth and Moon; and alſo a moveable Sun and Earth, ſo that the *Ptolemaic* and *Copernican* Syſtems may be both repreſented.

And to thoſe who may be deſirous of making deeper reſearches into this noble Science, I would alſo inform them, that, by peruſing *Ferguſon's Aſtronomy*, and *Martin's Young Gentlemens and Ladies Philoſophy*, they will there find it more fully treated than is the intention of theſe Inſtructions.

*FINIS.*